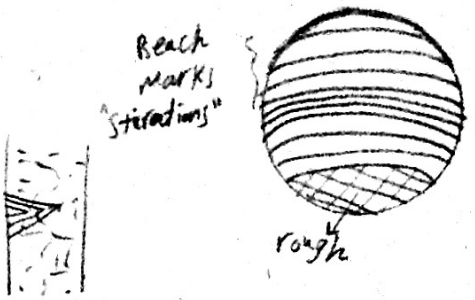
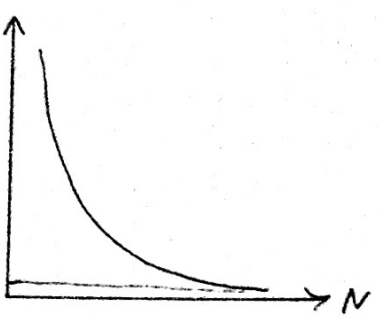
a) Intrinsic: conductivity, strength, elastic Modulus, recycling.
Attributive: Transparency, surface finish, price.

b) Beach Marks ⟶ crack initiation area & propagation.
rough area ⟶ fracture failure due to high stress.



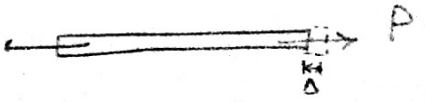
c) S-N curve: relation between fatigue stress & No. of cycles.
fatigue limit: stress at which material can sustain infinite no. of cycles.
endurance limit: stress at which material can sustain infinite no. of cycles.



d) (: Like ☺

e) $U = \frac{1}{2} P \Delta$

$\Delta = \frac{PL}{EA}$; $\sigma = P/A \Rightarrow P = \sigma A$



$U = \frac{1}{2}(\sigma A)\left(\frac{\sigma A L}{E A}\right)$

$U = \frac{1}{2}\frac{\sigma^2 A L}{E}$

ex. Moving elevator at speed "v". If the wire get jammed suddenly, there is stress will be found where $U = \frac{1}{2} m v^2$, which may make the wire fail so if the wire was taller or has a wide cross section area or small Modulus of elasticity.

f) $\sigma = \frac{M}{I} y$

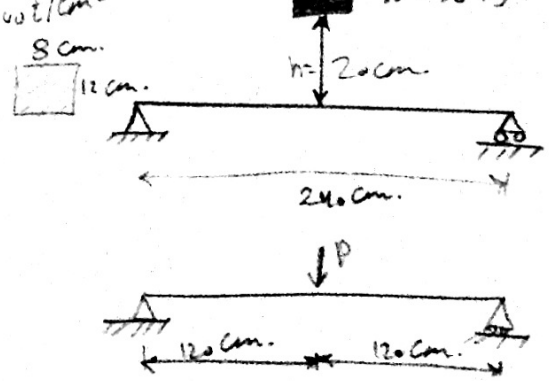
$M = \frac{PL}{4}$, $I = \frac{8(12)^3}{12} = 1152\ cm^4$

$\sigma = \frac{P(240)(6)}{(1152)(4)} = \frac{5}{16} P$

$P = 3.2\ \sigma$

$\Delta = \frac{PL^3}{48 EI} = 1.25 \cdot 10^{-4} P = 4 \cdot 10^{-4} \sigma$

$E = 2000\ t/cm^2$



$W(h+\Delta) = \frac{1}{2} P \Delta$

$30(20 + 4 \cdot 10^{-4}\sigma) = \frac{1}{2}(3.2\sigma)(4 \cdot 10^{-4}\sigma)$

$\sigma = 977.66\ Kg/cm^2$

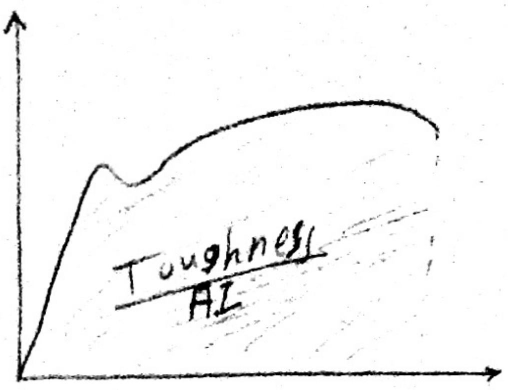
$\Delta = 0.391\ cm.$

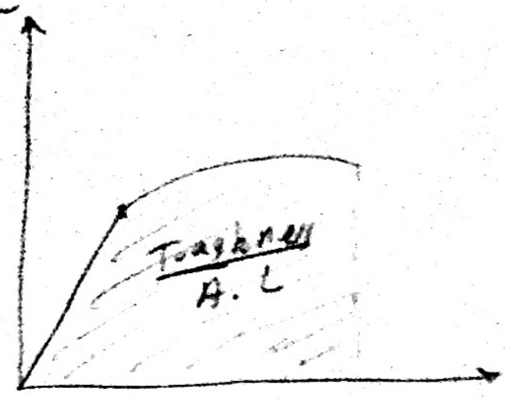
$P = 3128.512\ Kg$

$K_d = \frac{P}{W} = 104.283$

The value of falling wieght can be increased by: 1) rotating the beam 90°.
2) Increasing the hieght "h".

g)





i) $A = 1.12\ cm^2$
$l_o = 120\ mm$

① $\sigma_y = \frac{P_y}{A} = \frac{3.136 \times 10^3}{1.12} = 2800\ Kg/cm^2$

$\sigma_u = \frac{P_u}{A} = \frac{5.6 \times 10^3}{1.12} = 5000\ Kg/cm^2$

$E = \frac{PL}{\Delta A} = \frac{3.6 \times 12}{0.01935 \times 1.12} = 1993.35\ t/cm^2$

$\%\ elongation = \frac{\Delta_{max}}{l_o} = \frac{3.6}{12} \times 100 = 30\%$

② $\sigma_D = \frac{\sigma_y}{f.o.s}$

f.o.s = 1.5

$\sigma_D = \frac{2800}{1.5}$

$\sigma_D = 1866.67\ Kg/cm^2$

$\sigma_D = \frac{P}{A}$

$\frac{\pi D^2}{4} = \frac{30000}{1866.67}$

D = 4.523 cm

f.o.s = 2.5

$\sigma_D = \frac{2800}{2.5}$

$\sigma_D = 1120\ Kg/cm^2$

$\sigma_D = \frac{P}{A}$

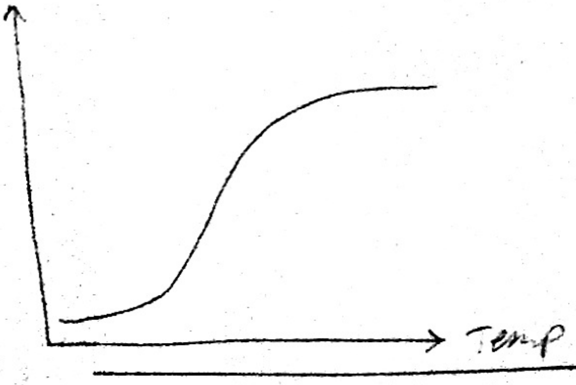
$\frac{\pi D^2}{4} = \frac{30000}{1120}$

D = 5.834 cm.

If we use f.o.s of 2.5, we will need larger cross section which represents more material.

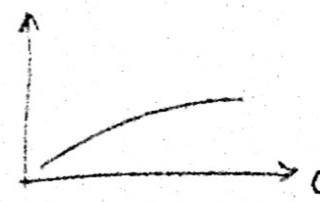
K) مش عارفها

m) Impact energy in Charpy test & temperatures:



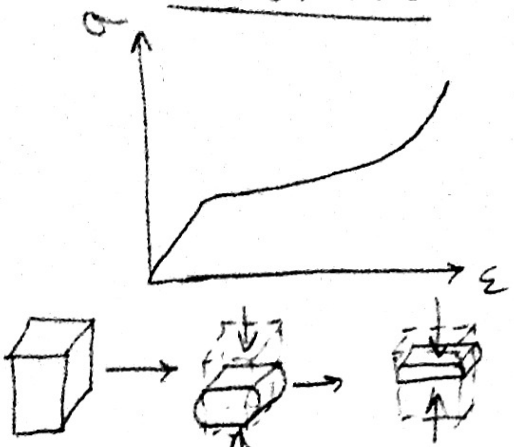
Impact energy & yield stress:

غير متأكد منها

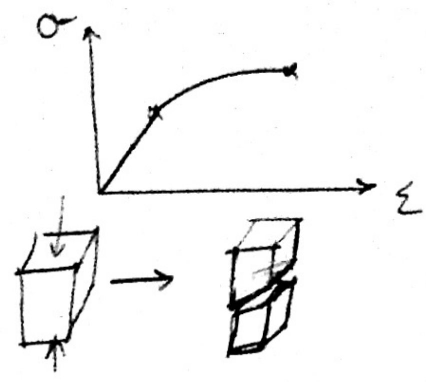


a)

Ductile material



Brittle Material



b) Indetation hardness test, rebound hardness test "suitable to ceramic Materails"; scratch hardness test, wear hardness test, Machineability hardness test.

c)

$$HB = \frac{P}{\frac{\pi D}{2}\left[D - \sqrt{D^2 - d^2}\right]}$$; $\frac{P}{D^2} = 30 \longrightarrow D = 6.05\,mm$ & $d = 2.6\,mm$.

$HB = 197.148$

$TS = 0.36\,HB = 70.973\ kg/mm^2$.

d)

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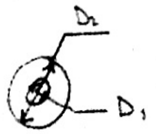
e) $L = 1.5\,m$.

$D_2 = 60\,mm$.

$D_1 = 40\,mm$.

$T = ??$

$\tau \leq 120\,MPa$.



$G = 77.2\,GPa$.

$$\tau = \frac{T}{I_p}\,c$$

$$T = \frac{\tau\, I_p}{c}$$

$$T = \frac{120 \cdot 1.021 \cdot 10^6}{30}$$

$T_{max} = 4.084 \cdot 10^6\ N.mm.$

$$I_p = \frac{\pi (D_2^4 - D_1^4)}{32} = 1.021 \cdot 10^6\ mm^4$$

$$\tau_{min} = \frac{T}{I_p}\,y$$

$$\tau_{min} = \frac{4.084 \cdot 10^6}{1.021 \cdot 10^6}(20)$$

$\tau_{min} = 80\,MPa.$

$$\theta = \frac{T.L}{I_p.G} = 0.077\ rad. = 4.453^\circ$$